

Animal Naming Performance in Korean Elderly: Effects of age, education, and gender, and Typicality

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ABSTRACT

The animal naming test (ANT) is known to be influenced not only by age, gender, and education but only by ethnicity, culture, and language. Thus, population-specific norm considering these variables needs to be developed for Korean-speaking elderly. We evaluated 185 healthy elderly people with five measures. Education was the single statistically independent correlate of the total number of words ($R^2 = .312$, $p = .038$). After adjusting for education, there was slightly significant negative correlation ($r = -.215$, $p = .049$) between age and total number of words. Mean number of words produced was 13.71 ± 3.09 . The production frequency was negatively correlated with the typicality rating ($r = -0.41$, $p < .05$). The concrete and exact scoring rule could be set up in the comparison of naming performance between a normal and patient with neuro-linguistic disorder and its data could be utilized in a differential diagnosis for patients with neurological disorders.

Keywords: Semantic Verbal Fluency, Animal Naming, Korean Elderly, Typicality

1. INTRODUCTION

A verbal fluency test had frequently been used in both clinical and research purposes on neurological disorders[1]-[3]. Among these, Semantic Verbal Fluency (SVF) task such as category fluency (i.e., animal and supermarket item) had widely been known for providing the most valuable information in examinations of brain function and had been included in language assessment tools[4]-[6]. As it had well been known, the score of total words produced during 60-s trials was the most commonly used measure of performance. Many studies have had reported a significant age-related decline in the SVF task [7]-[9]. It enabled to identify the relations between cognitive function and SVF task as it showed reduced performance at the subclinical phase of Alzheimer's Disease[1].

Of these, a review of the literature shows that the category "animals" is most frequently employed [10]. In a previous research, animal naming fluency was found to be associated

with age, education, and language background, but not gender [10]-[15]. The influence of age have been reported in both Canadian study (60-79 years vs 80-95 years) [10] and Spanish-speaking elderly study (60-69 years vs 70-79 years) [14]. Fluency for animal naming was also found to be affected by education and age in normal Chinese, Vietnamese, and Brazilian samples who were tested in their native language[11], [12].

It has been shown that non-English speaking populations are not only affected by age and education, but also show differences in ANT performance depending on ethnicity. For instance, it is known that Vietnamese speakers generate mostly animal names, whereas Spanish speakers generate animal names the least. Besides, the animals most frequently mentioned also differed among ethnic groups[12]. For example, ox and buffalo were common for Vietnamese; rat was a common response by the Chinese; burro was frequently mentioned by Spanish speakers; giraffe was frequently named by English speakers but not the others. The variety of animal

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names generated by different ethnic groups reflects the fact that vocabulary size may differ among populations having different cultural and linguistic backgrounds. Thus, the vocabulary size and variety of naming responses of Korean speakers may be different from those of people from other cultural backgrounds.

Although an ANT is utilized in the clinical setting for the differential diagnosis of patients with degenerative disease or stroke, and for follow-up of their neurological status, there are few comprehensive and specific norms presented across the entire elderly age range. In some of the previous studies of the effects of normal aging on this SVF task [2], [16], the norm was presented including all adults over the age of 65 in one older age group, or even with younger adults in the same group, thus failing to provide clinically useful information. In particular, considering the fact that the incidence rate of Alzheimer's disease and stroke is higher in the elderly population, that generation of animal names contributed more to the diagnosis of dementia than other cognitive tasks, and that treatment generalization level is evaluated on the basis of word typicality in aphasia patients with naming difficulties [17], the ANT performance of the elderly population needs to be investigated more carefully in terms of the quantity and quality of names generated in order to satisfy the objectives of assessment and treatment.

Recently, studies have been conducted on the application of a treatment in which the typicality level was adjusted, and the effect of this treatment on patients having naming difficulties. naming treatment effect now regularly shows that it helps lexical retrieval by manipulating the typicality of category examples [18], a typicality study suitable for Korean language and culture represents a fundamental and very necessary study. However, due to the lack of a concrete analysis leading to examples of the performance of SVF tasks in Korean samples thus far, a comparison has not been possible with respect to performance with other languages or with other cultural areas. Thus, studies could not be conducted on the treatment effect on patient groups experiencing this type of naming difficulty.

Therefore, works to identify examples of items included in specific categories of Korean sample would help to heighten the inter-rater reliability in rating scores of naming responses in the future psychometric testing [19]. Works to investigate the production frequency of items included in specific categories and to divide typical category and atypical category could be basic data to establish an intervention model applicable to patients with neuro-linguistic communicative disorders, showing naming impairment such as aphasia and dementia.

The scoring rule provided by Troyer, Moscovitch, and Winocur [16] had mainly been used for the analysis on performance of the SVF task conducted all the while. In addition, the scoring rule suggested in studies by Troyer (2000), Robert et al. (1998), and Abwender et al. (2001) had been used to analyze performance of the SVF task [20]-[22]. There was no universal scoring rule used in all cultural and linguistic field because different methods had been used to rate the clustering and switching in many studies and categorization rule of animal category had been different little by little. It might be more accurate to investigate the total number of words generated, the cluster size, and the number of switching after excluding the number of repetitions and intrusions shown in naming response

if the SVF task was used to check the progress of neurological disease and for early discrimination.

Thus, the purpose of this study was to (1) investigate the effects of age, education, and gender on animal naming; (2) and to investigate vocabulary size and characteristics of animal naming in elderly Koreans through the rating of the production frequency and typicality of animal names generated, and thus provide the fundamental data that can be applied toward the creation of norms for the Korean-speaking population.

II. METHODS

1. Study Population

Initially, One hundred eighty five community-dwelling elderly subjects over 65 years of age living in Seoul's metropolitan area were recruited. Participants who met the following selection criteria were selected from the pool: 1) having a normal cognitive function as screened by the Korean version-Mini-Mental Status Examination (K-MMSE) [23]; 2) being able to complete naming task without assistance; and 3) being able to give informed consent. Informed consent was obtained after detailed explanation regarding the aim of the study. This study has been approved by the Institutional Review Board (IRB) of Yonsei University College of Medicine (no. 1-2011-0061). Exclusion criteria consisted of the following: 1) having depression screened by the Geriatric Depression Scale Short Form – Korean version (GDSSF-K) [24]; 2) having health conditions related to deterioration of cognitive functions as proposed by Christensen et al. [25].

All the participants scored within the normal range ($M = 28.23$, $SD = 1.26$) on the K-MMSE. Of the 185 participants, male was 85 (45.95%) and female was 100 (54.05%). They were ranged in age from 65 to 84 years ($M = 73.87$, $SD = 5.04$). The education level varied from 9 to 19 years ($M = 11.9$, $SD = 2.43$).

2. Materials and Procedure

Participants were instructed to produce as many different animal names as possible. All the responses of subjects were audio-recorded and transcribed. The followings were obtained from the ANT: (1) the total number of words generated excluding perseverative errors and intrusive errors; (2) the number of switches; (3) the mean cluster size; (4) the production frequency (%) of animal names calculated from an ANT; and (5) typicality.

For total number of words, the number of switches, and the mean cluster size, we applied the analysis method suggested in a study by Troyer, Moscovitch, and Winocur [16]. But, this study adjusted the categorization rule of separating subcategory from animal category to Korean culture and language. It also excluded the number of repetitions and intrusions from the analysis of the total number of words, the number of switches, and the mean cluster size. The study calculated how many subjects mentioned relevant animal names among the whole subject by counting the number of all the animal names mentioned by the subject in relation to the production frequency (%) of each animal name calculated from the ANT.

For typicality evaluation, 40 healthy old people rated the previously generated animal items for each of the fifty names with the highest production frequency. The study respectively regarded rating 1 and 7 as “most typical and very good example” and “least typical and very poor example” by applying a method suggested by Rosch (1973)[26]. The calculation of the five measures obtained by ANT was made twice to check the inter-rater reliability. The reliability of the five response was .96~.98. All showed the excellent inter-rater reliability.

3. Data Analyses

The demographic variables of age, gender, and years of education were reported to have different effects on the SVF task performance depending on the specific culture and language. Hence, the presentation of normative data in the animal naming responses stratified using the demographic factors such as age, years of education, and gender does not show any difference with regard to the findings in previous studies. Therefore, multiple linear regression were applied to examine the linear relationship between the three test variables (i.e., total number of words, number of switches, mean cluster size) and the demographic factors such as age, years of education, and gender. Therefore, we adjusted the influential variables and investigated the changing patterns of the test variables while increasing age. In addition, the study suggested data on production frequency (%) and typicality rating by the animal name in each animal category. All statistical analyses were carried out using the PASW statistics 18.0 (SPSS, Chicago, III).

III. RESULTS

1. Normative data

Multiple linear regression analysis was conducted while assuming the demographic factors of age, years of education, and gender was independent variables. As a result, years of education was the single statistically independent correlate of the total number of words ($R^2 = .312$, $p = .038$). However, the effects of age and gender were not evident for all three test variables (i.e., total number of words, number of switches, mean cluster size), as presented in Tab. 1. After adjusting for years of education, There was slightly significant negative correlation ($r = -.215$, $p = .049$) between age and total number of words. The mean cluster size ($r = .025$, $p = .830$) and

number of switches ($r = -.065$, $p = .572$) did not show a significant correlation with age as the increasing age in the elderly group, but the total number of words showed a gradual decrease. Mean total number of words produced was 13.71 ± 3.09 . The mean of number of switches and mean cluster size were 4.30 ± 1.93 and 2.60 ± 0.67 , respectively.

Fig. 1 is a line graph showing the average scores in the total number of words generated, the number of switches, and the mean cluster size of the elderly in each age group (on yearly basis) between 65 and 84. Results of correlation analysis among the three test variables were as follows. The total number of words showed a positive correlation with the number of switches ($r = .463$, $p = .0001$). However, mean cluster size showed a negative correlation with the number of switches ($r = -.251$, $p = .043$).

2. Production frequency of animal names generated

50 names estimated among 65-84 age groups were arranged in order of the production frequency (%) (Table 2). The most mentioned animal name was ‘cow’ which was produced by 165 out of 182 (90.66%) subjects. Following cow (90.66%) were pig (77.47%), dog (70.88%), tiger (68.68%), horse (68.13%), and lamb (60.99%). As a result, those sub-categories that animal names were continuously illustrated more than 3 within the same sub-category, items with the highest production frequency were livestock domestic animal - animals of tropical areas such as jungles and safari areas – birds - ocean animal - insects in order.

3. Typicality

Table 3 gives the average typicality. The typicality rating of the top fifty animal names with a high production frequency showed that the typicality was in the order of domestic livestock animal - animals of tropical areas such as jungles and safari areas – birds - ocean animals – and insects, from the most typical category to the least typical category. This was nearly identical to the order of the subcategories with the highest production frequency. The Pearson’s correlation was $-.041$ ($p < .05$) between the production frequency and the typicality rating.

Table 1. Multiple linear regression analysis between three test variables and subject demographic variables

Covariate	Total number of words		Number of switches		Mean cluster size	
	B	Std. Error	B	Std. Error	B	Std. Error
(Constant)	14.849*	6.113	5.664	4.048	2.951	1.392
Years of education	.312*	.149	-.004	.099	.021	.034
Gender	1.101	.731	.237	.484	-.217	.166
Age	-.092	.069	-.023	.046	-.004	.016

Note. * $p < .05$

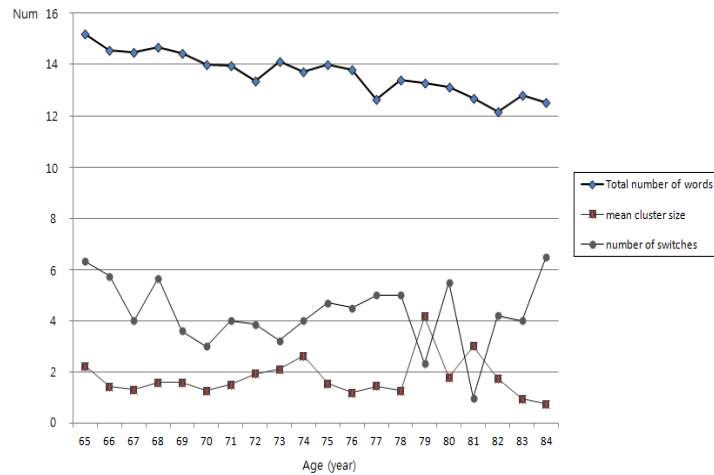


Fig. 1 . Mean scores of test variables according to age, adjusted for education

Table 2. Production frequency of animal names generated

variable	Production frequency (%)	variable	Production frequency (%)	variable	Production frequency (%)	variable	Production frequency (%)
cow	90.66	fox	37.91	squirrel	13.19	crane	3.85
pig	77.47	sparrow	35.71	kangaroo	12.09	eagle	3.85
dog	70.88	goat	32.42	dove	10.99	wild goose	3.85
tiger	68.68	bear	30.22	raccoon	8.79	rhinoceros	3.85
horse	68.13	snake	28.02	ostrich	7.14	whale	2.75
sheep	60.99	elephant	25.27	swallow	6.04	tuna	2.75
rabbit	58.79	deer	22.53	leopard	8.79	saury	2.75
hen	56.59	wolf	22.53	seal	7.14	hyena	2.75
cat	55.49	duck	22.53	water buffalo	6.04	beetle	2.20
monkey	51.10	crow	21.98	crocodile	6.04	larva	2.20
lion	45.60	magpie	19.78	frog	4.95	scorpion	2.20
giraffe	41.21	hippo	17.03	penguin	4.95		
mouse	37.91	camel	13.19	owl	4.95		

Table 3. Exemplars, mean typicality rating for 65-84 year age group

variable	Average typicality	variable	Average typicality	variable	Average typicality	variable	Average typicality
cow	1.00 ¹ (0.00)	deer	1.20(0.45)	duck	2.00(1.00)	swallow	2.60(1.14)
pig	1.00(0.00)	rabbit	1.40(0.55)	sheep	2.20(2.17)	squirrel	2.80(1.17)
dog	1.00(0.00)	fox	1.40(0.55)	hen	2.20(1.10)	seal	2.80(1.92)
tiger	1.00(0.00)	goat	1.40(0.55)	crow	2.20(1.10)	whale	2.80(2.05)
lion	1.00(0.00)	hippo	1.40(0.55)	magpie	2.20(1.10)	mouse	3.00(2.35)
bear	1.00(0.00)	camel	1.40(0.55)	dove	2.20(1.10)	snake	4.40(2.30)
wolf	1.00(0.00)	kangaroo	1.40(0.55)	owl	2.20(1.10)	tuna	4.80(1.64)
leopard	1.00(0.00)	rhinoceros	1.40(0.89)	eagle	2.20(1.10)	saury	5.20(1.79)
horse	1.20(0.45)	hyena	1.40(0.89)	ostrich	2.40(0.89)	scorpion	6.00(0.85)
cat	1.20(0.45)	raccoon	1.60(0.65)	frog	2.40(1.14)	beetle	6.40(0.55)
monkey	1.20(0.45)	water buffalo	1.40(0.89)	crane	2.40(0.80)	larva	6.60(0.45)
giraffe	1.20(0.45)	crocodile	1.40(0.89)	sparrow	2.60(1.14)		
elephant	1.20(0.45)	penguin	1.60(0.65)	wild goose	2.60(1.14)		

Note. Mean(SD)

¹: 1 means the most typical; 7 means the least typical.

IV. DISCUSSIONS

Age and education are considered to be very influential variables in animal name generation [12], [20], [27], [28]. Likewise, this study confirmed that the education is the important variable affecting the animal naming generation. Also, the significant correlation of lower animal naming generation with increasing age when the education variable was adjusted proved the existence of age effect in the elderly population. This result is consistent with the previous report where the 'young old' and 'old old' group showed a difference in the verbal fluency task [12], [28].

Moreover, this study provides findings that differentiate previous reports in several ways. First, a considerable number of previous reports investigated the number of names generated in the animal naming task with elderly, adult, and adolescent subjects assigned to a single group, while this study investigated the effects of age, education, and gender only within the elderly population.

Second, in previous reports, the effects of age, education, and gender were investigated first, and then the subjects were stratified into multiple groups to present the number of total animal names generated [10], [11], [14]. However, norms that are provided differently depending on the age, education level, and linguistic differences of the subjects cannot provide significantly relevant information when they are applied in an actual clinical setting. In addition, no comprehensive norms have yet been provided that may be applied to Korean elderly. This study showed the pattern of change in animal naming generation performance purely based on aging, by means of investigating the effects of age, education, and gender through multiple regression analysis and adjusting them.

Third, the qualitative parameters of cluster and switches are known to be helpful to identify automatic cognitive processes and executive processes [1]. Thus, these qualitative parameters have also been used as a type of discriminative index for patients with Huntington's disease, Parkinson's disease, and dementia associated with Alzheimer's disease. The effect of age on clustering and switching has been reported in various studies [16], [20]. In particular, increased age is known to show decreased switching in animal naming fluency tasks, and a higher level of education is considered to be more related to switching [20]. However, there was no decline in age-related switching ability. The mean cluster size showed the same pattern. Thus, the effect of demographic variables such as age and education may be very weak on the clustering and switching competence in a normal Korean elderly group.

Additionally, the fact that the clustering and switching ability was maintained regardless of age and the level of education may help inform the differential diagnoses of patients with neurological disorders. However, considering the discrepant results in the SVF task performed by the normal elderly and the patients with neurological disorders [29], [30], any interpretation should be made carefully when using these qualitative parameters as a discriminative index for the normal elderly and patient groups.

Fourth, the hypothesis of this study that each ethnicity demonstrates a different quantity and quality of animal naming responses derived a novel finding. In the study of Kempler et al.

[1], where animal naming was investigated in subjects aged between 55 and 92, the number of animal names generated was 17.3, the highest, in Vietnamese subjects, and 12.8, the lowest, in Hispanic subjects, while the Korean elderly generated 13.7 animal names on average, which was lower than the norm with respect to Caucasian, African American, and Chinese populations, but similar to the norm reported for Brazilian subjects (mean age: 49.42).

In addition, we determined the most frequently generated variety of animals in Korean culture through analysis of the production frequency (%). In the study of Kempler et al. [1], ox and buffalo were common responses for Vietnamese subjects; burro was frequently mentioned by Spanish speakers; rat was a common response given by the Chinese subjects; and giraffe was frequently named by English speakers, but not by others. On the other hand, the current study demonstrated that cow was the animal most frequently named by Koreans. One finding that was much unanticipated was that all 10 of the animals showing the highest production frequency were among the twelve Chinese zodiac signs that exist only in Chinese and Korean cultures. In China and Korea, a zodiac sign bearing the identity of an animal is given to a person according to his or her year of birth. The names of these Chinese zodiac signs include not only livestock and domestic animals such as pig, dog, horse, and sheep, but also tropical or wild animals such as tiger, monkey, and rabbit, in addition to reptiles such as snake. Thus, a unique quality of animal naming in the Korean population is that it is affected by not only the environmental familiarity but also by the twelve animals corresponding to the Chinese zodiac signs.

Finally, in this study, a typicality rating was performed for the individual items. The result showed that the animals that showed a high production frequency had a high typicality level in general. The typicality of the animal subcategory was high in the order of domestic livestock animal - animals of tropical area such as jungles and safari areas - birds - ocean animal - insect. The names of the animals that are frequently encountered in daily life showed a higher typicality level. However, animals that are less familiar in the Korean culture, such as the camel, kangaroo and water buffalo, were also rated closely to the level of "most typical." Based on this result, familiarity was not the only factor that determines the typicality level [31].

Typicality can be understood on the basis of semantic complexity theory. It can provide the important data needed to formulate a naming intervention and language recovery strategy in patients with neurological communicative disorders. The treatment generalization level is known to be higher in general for atypical items than for typical items in aphasia patients who have naming difficulty [17]. It is known that patients with AD, a degenerative disease, are able to name more typical items well only in the semantic category in the early stage of the disease [32], but they partially lose their naming ability in the developmental stage, starting with words acquired later [33], [34]. Additionally, AD patients are known to define atypical and low-frequency words better in word definition tasks [35]. However, to understand the word definition task performance of AD patients, the typicality and production frequency of individual words should be conducted in advance. For example, 'mouse' was a high-frequency word

in this study, but it belonged to the atypical animal category. Moreover, the result may also depend on different languages and cultures.

V. CONCLUSIONS

The present study provides several pieces of useful information regarding the study of animal naming fluency among Korean populations. (1) The cluster size and switching may be important discriminative factors for patients with neurological disorders, while the total number of words of animal naming may be a more sensitive factor in normal aging. Particularly, the total number of words generated is greatly affected by education. (2) There is no normative norm for animal categorization in Korea at this point; thus, researchers typically apply different categorization rules. Hence, a comparison among naming studies will be more reliable if the animal categorization rule proposed in this study is applied for clinical or research purposes in the future. (3) The typicality in this study may be applied in the future in a typicality treatment approach involving the prompting with lexical retrieval in neurological communicative disorder patients with naming difficulty in Korea. Moreover, the approach can be applied in the early detection and differential diagnosis of AD patients by considering the word attributes of a psychometric test and investigating the process of the language impairment in early AD patients. Ultimately, this study will provide the basis for the development of a language intervention model tailored for dementia and patients with naming difficulty. On the basis of this study, we will establish a category dictionary for Korean samples and examine the effect of typicality training on a patient group.

REFERENCES

- [1] N. Raoux, H. Amieva, M. Le Goff, S. Auriacombe, L. Carcaillon, L. Letenneur et al, "Clustering and Switching Processes in Semantic Verbal Fluency in the Course of Alzheimer's Disease Subjects: Results from The PAQUID Longitudinal Study ", *Cortex*, vol. 44, no. 9, 2008, pp. 1188-1196.
- [2] N. Haugrud, S. Lanting, M. and Crossley, "The Effects of Age, Sex and Alzheimer's Disease on Strategy Use During Verbal Fluency Tasks ", *Neuropsychology, Development, and Cognition. Section B, Aging, Neuropsychology and Cognition*, vol. 17, no. 2, 2010, pp. 220-239.
- [3] A. Ardilla, F. Ostrosky-solis, and B. Bernal, "Cognitive Testing Toward the Future: The Example of Semantic Verbal Fluency (animals) ", *International Journal of Psychology*, vol.41, no. 5, 2006, pp. 324-332.
- [4] H. Kim, J. Kim J, D.Y. Kim, and J. Heo, "Differentiating Between Aphasic and Nonaphasic Stroke Patients Using Semantic Verbal Fluency Measures with Administration Time of 30 Seconds ", *European Neurology*, vol. 65, no. 2, 2011, pp. 113-117.
- [5] A. Kertesz, *The Western Aphasia Battery-Revised (WAB-R)*, New York, Grune & Stratton, 2007.
- [6] H. Goodglass, F.B. Kaplan, B. Barresi, *Boston Diagnostic Aphasia Examination (BDAE)*, ed 3, Austin, Pro-ed, 2001.
- [7] G. Kavé, "Standardization and Norms for a Hebrew Naming Test ", *Brain and Language*, vol. 92, no. 2, 2005, pp. 204-211.
- [8] S. Lanting, N. Haugrud, and M. Crossley, "The Effect of Age and Sex on Clustering and Switching During Speeded Verbal Fluency Tasks ". *Journal of the International Neuropsychological Society*, Vol. 15, no. 2, 2009, pp. 196-204.
- [9] J. Bryan, and M.A. Luszcz, "Measures of Fluency as Predictors of Incidental Memory Among Older Adults ", *Psychology and Aging*, vol. 15, no. 3 2000, pp. 483-489.
- [10] T.N. Tombaugh, J. Kozak, and L. Rees, "Normative Data Stratified by Age and Education for Two Measures of Verbal Fluency: FAS and Animal Naming ", *Archives of Clinical Neuropsychology*, vol. 14, no. 2, 1999, pp. 167-177.
- [11] S.M.D. Brucki, and MSG. Rocha, "Category Fluency Test: Effects of Age, Gender and Education on Total Scores, Clustering and Switching in Brazilian Portuguese-Speaking Subjects ", *Brazilian Journal of Medical and Biological Research*, vol. 37, no. 12, 2004, pp. 1771-1777.
- [12] D. Kempler, E.L. Teng, M. Dick, I.M. Taussig, and D.S. Davis, "The Effects of Age, Education, and Ethnicity on Verbal Fluency ", *Journal of the International Neuropsychological Society*, vol. 4, no. 6, 1998, pp. 531-538.
- [13] K.I. Bolla, S. Gray, S.M. Resnick, R. Galante, and C. Kawas, "Category and Letter Fluency in Highly Educated Older Adults ", *Clinical Neuropsychology*, vol. 12, no. 3, 1998, pp. 330-338.
- [14] A. Acevedo, D.A. Loewenstein, W.W. Barker, D.G. Harwood, C. Luis, M. Bravo et al, "Category Fluency Test: Normative Data for English and Spanish-Speaking Elderly ", *Journal of the International Neuropsychological Society*, vol. 6, no. 7, 2000, pp. 760-769.
- [15] E. Capitani, M. Laiacona, and R. Barbarotto, "Gender Affects Word Retrieval of Certain Categories in Semantic Fluency Tasks ", *Cortex*, vol. 35, no. 2, 1999, pp. 273-278.
- [16] A.K. Troyer, M. Moscovitch, and G. Winocur, "Clustering and Switching as Two Components of Verbal Fluency: Evidence from Younger and Older Healthy Adults ", *Neuropsychology*, vol. 11, no. 1, 1997, pp. 138-146.
- [17] S. Kiran, and C.K. Thompson, "Effect of Typicality on Online Category Verification of Animate Category Exemplars in Aphasia ", *Brain and Language*, vol. 85, no. 3, 2003, pp. 441-450.
- [18] S. Kiran, C. Sandberg, and R. Sebastian, "Treatment of

- Category Generation and Retrieval in Aphasia: Effect of Typicality of Category Items ", *Journal of Speech, Language, and Hearing Research*, vol. 54, 2011, pp. 1101-1117.
- [19] T.P. Ross, " The Reliability of Cluster and Switch Scores for the Controlled Oral Word Association Test ", *Archives of Clinical Neuropsychology*, vol. 18, no. 2, 2003, pp. 153-164.
- [20] A.K. Troyer, " Normative Data for Clustering and Switching on Verbal Fluency Tasks ", *Journal of Clinical and Experimental Neuropsychology*, vol. 22, no. 3, 2000, pp. 370-378.
- [21] D.A. Abwender, J.G. Swan, J.T. Bowerman, and S.W. Connolly, " Qualitative Analysis of Verbal Fluency Output: Review and Comparison of Several Scoring Methods ", *Assessment*, vol. 8, no. 3, 2001, pp. 323-338.
- [22] P.H. Robert, V. Lafont, I. Medecin, L. Berthet, S. Thauby, and C. Baudu, " Clustering and Switching Strategies in Verbal Fluency Tasks: Comparison between Schizophrenics and Healthy Adults ", *Journal of the International Neuropsychological Society*, vol. 4, no. 6, pp. 539-546.
- [23] Y. Kang, D.L. Na, and S. Hahn, " A Validity Study on the Korean Mini-Mental State Examination (K-MMSE) in Dementia Patients ", *Journal of Korean Neurological Association*, vol. 15, no. 2, 1997, pp. 300-308.
- [24] B.S. Ki, A Preliminary Study for the Standardization of Geriatric Depression Scale Short Form-Korea Version, *Journal of the Korean Neuropsychiatric Association*, vol. 35, no. 2, 1996, pp. 298-307.
- [25] K.J. Christensen, K.S. Multhaup, S. Nordstrom, and K. Voss. A Cognitive Battery for Dementia: Development and Measurement Characteristics. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, vol. 3, no. 2, 1991, pp. 168-174.
- [26] E. Rosch, On the Internal Structure of Perceptual and Semantic Categories. In TE. Moore (ed.), *Cognitive Development and the Acquisition of Language* (pp. 111-144). New York: Academic Press, 1973.
- [27] J. Corey-Bloom, W.C. Wiederholt, S. Edelstein, D.P. Salmon, D. Cahn, and E. Barrett-Connor, " Cognitive and Functional Status of the Oldest Old " . *Journal of the American Geriatrics Society*, vol. 44, no. 6, 1996, pp. 671-674.
- [28] M. Crossley, C. D'Arcy, and S.B. Rawson, " Letter and Category Fluency in Community-Dwelling Canadian Seniors: A Comparison of Normal Participants to Those with Dementia of the Alzheimer of Vascular Type ", *Journal of Clinical and Experimental Neuropsychology*, vol. 19, no. 1, 1997, pp. 52-62.
- [29] A.K. Troyer, M. Moscovitch, G. Winocur, M.P. Alexander, and D. Stuss, " Clustering and Switching on Verbal Fluency: The Effects of Focal Frontal- and Temporal-Lobe Lesions ", *Neuropsychologia*, vol. 36, no. 6, 1998, pp. 499-504.
- [30] E.G. March, and P. Pattison, " Semantic Verbal Fluency in Alzheimer's Disease: Approaches Beyond the Traditional Scoring System ", *Journal of Clinical and Experimental Neuropsychology*, vol. 28, no. 4, 2006, pp. 549-566.
- [31] B.C. Malt, and E.E. Smith, " The Role of Familiarity in Determining Typicality ", *Memory & Cognition*, vol. 10, no. 1, 1982, pp. 69-75.
- [32] K.E. Forbes-McKay, A.W. Ellis, M.F. Shanks, and A. Venneri, " The Age of Acquisition of Words Produced in a Semantic Fluency Task can Reliably Differentiate Normal from Pathological Age Related Cognitive Decline ", *Neuropsychologia*, vol. 43, no. 11, 2005, pp. 1625-1632.
- [33] H. Kremin, D. Perrier, M. De Wilde, M. Dordain, A. Le Bayon, P. Gatignol et al, " Factors Predicting Success in Picture Naming in Alzheimer's Disease and Primary Progressive Aphasia ", *Brain and Cognition*, vol. 46, no. 1-2, 2001, pp. 180-183.
- [34] M.C. Silveri, A. Cappa, P. Mariotti, and M. Puopolo, " Naming in Patients with Alzheimer's Disease: Influence of Age of Acquisition and Categorical Effects ", *Journal of Clinical and Experimental Neuropsychology*, vol. 24, no. 6, 2002, pp. 755-764.
- [35] A.J. Astell, and T.A. Harley, " Accessing Semantic Knowledge in Dementia: Evidence from a Word Definition Task ", *Brain and Language*, vol. 82, no. 3, 2002, pp. 312-326.



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Appendix. Categorization rules for semantic category

Category	Subcategory	Examples
(a)	fish	shark, mackerel pike, hairtail, yellow corbina, catfish, eel, carp, whiting, whale ¹
(b)	amphibian	frog, polliwog, toad, narrow-mouthed toad, salamander
(c)	reptile	snake(cobra, rattlesnake, python, serpent), turtle, terrapin, crocodile, lizard, iguana, dinosaur, chameleon
(d)	birds	mallard, owl, night owl, hawk, eagle, sparrow, swallow, crow, magpie, goose, wild geese, scoter, swan, water bird, pheasant, ostrich, penguin, Chinese oriole, mandarin duck, turkey, kite, mynah, peacock, cuckoo, stork, parrots
(e)	livestock domestic animal	hen, chicken, horse, foal, ox, milk cow, calf, duck, pig, rabbit, goat, sheep, donkey, domestic goose, dog, puppy, cat
(f)	insects	grasshopper, mantis, dragonfly, butterfly, swallowtail, larva, moth, mosquito, bee, beetle, spider, stag beetle, scorpion, earthworm
(g)	ocean animal	true seal, seal, shrimp, octopus, squid, otter, sea urchin, jellyfish, sea anemone, starfish, mussel, crab, sea horse, lugworm, leech, shell
(h)	animals of tropical area such as jungles and safari areas	wild boar, roe deer, tiger, lion, bear, half-moon bear, polar bear, wild rabbit, elk, badger, raccoon, wild dog, coyote, mountain goat, zebra, giraffe, hedgehog, hippo, monkey, orangutan, elephant, rhinoceros, mouse, camel, kangaroo, turtle, leopard, wolf, cheetah, hyena, weasel, bat, dragon ²

¹: Although the whale is a mammal, in general, the elderly paired whales and fish while naming. Thus, in this study, whales are categorized as a type of fish.

²: Although a dragon is an imaginary animal, it is a frequently generated name in Korean culture in relation to the twelve animals corresponding to the Chinese zodiac. Thus, it was considered as a correct response.

Scoring rules for clustering and switching

1. Mean cluster size : cluster size was counted starting with the second word in a cluster.
2. Switching : number of transitions between clusters, including single words (e.g., frog-whale-gold fish-tiger, 2 switching)